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Spatio-Temporal Signatures of One- And Two-Mode Rough Walls in Turbulent Boundary Layers[1] JONATHAN MORGAN, BEVERLEY MCKEON, California Institute of Technology — A rough wall acts on a turbulent boundary layer flow by altering the wall boundary condition and creating persistent spatial inhomogeneity in the velocity field compared to a smooth-wall flow. A single Fourier mode of roughness, with height which varies in the streamwise and spanwise directions, will create a single static Fourier mode in the velocity field. Two or more Fourier modes of roughness will interact to create more complicated inhomogeneity. A finite number of roughness modes representing the largest scales of a realistic roughness geometry will begin to approximate the flow physics of the full roughness as the number of modes increases (Mejia-Alvarez and Christensen 2010). This study investigates the effect of simple roughnesses, consisting of one or two static height Fourier modes which vary in the streamwise and spanwise directions. The direct effect of the altered boundary condition is apparent in the inhomogeneous mean velocity field, while the indirect effect on the turbulent fluctuations is observed through the spatial inhomogeneity of the turbulent power spectrum and associated with specific nonlinear (triadic) interactions.

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